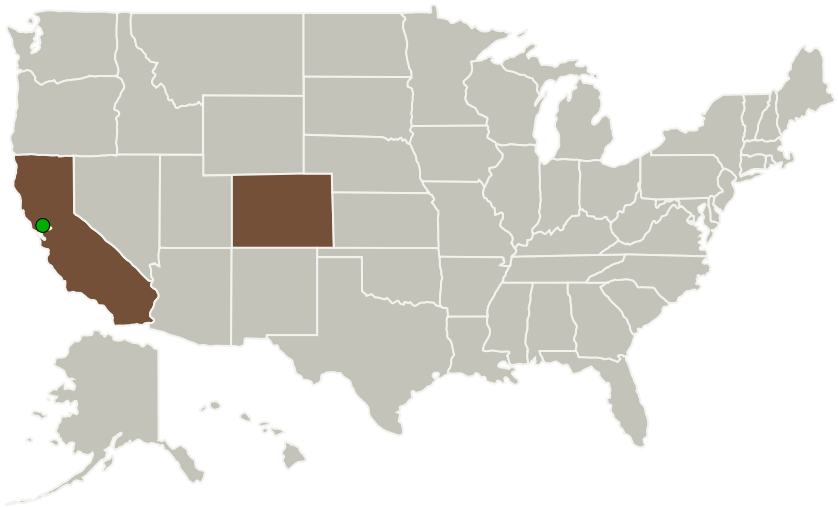
A Novel, Membrane-Based Bioreactor Design to Enable a Closed-Loop System on Earth and Beyond, Phase I

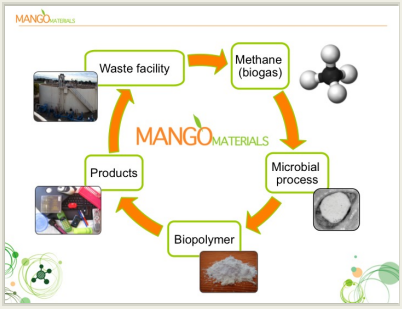
Completed Technology Project (2016 - 2017)

Project Introduction

The proposed innovation is a membrane bioreactor system to produce a biopolymer from methane gas. This new methane fermentation process will expand and advance current gas delivery techniques to create affordable fermentation methods on Earth and beyond. Mango Materials is currently working to scale up and commercialize the production of polyhydroxyalkanoate (PHA) from methane, but its scaled-up fermentation systems are typically tall and narrow to take advantage of hydrostatic pressure for the transfer of methane into solution. The proposed work represents a unique approach that could enable the production of biopolymer on Earth and also non-Earth environments, thus creating a closed-loop system for producing biopolymer products on-demand in outer space. The proposed design is a novel, membrane-based bioreactor that will enable bacterial growth and biopolymer production to occur in microgravity environments on moist membranes that are sandwiched between layers of the gaseous feedstocks methane and oxygen. This system will allow for efficient energy use, minimal square footage, and effective mass transfer from the gaseous to the liquid phase without being dependent on hydrostatic pressure. Mango Materials will partner with Colorado School of Mines where there is extensive experience with membrane bioreactors, to design and construct this system.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
Mango Materials Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Oakland, California
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
Colorado School of Mines	Supporting Organization	Academia	Golden, Colorado

Primary U.S. Work Locations	
California	Colorado

Project Transitions

June 2016: Project Start

June 2017: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139675)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Mango Materials Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Margaret C Morse

Co-Investigator:

Molly Morse

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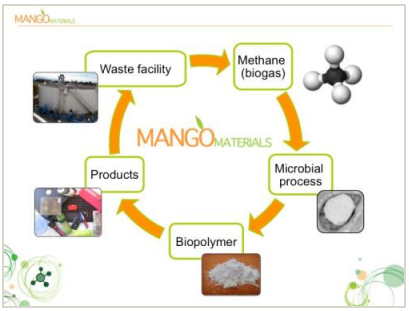
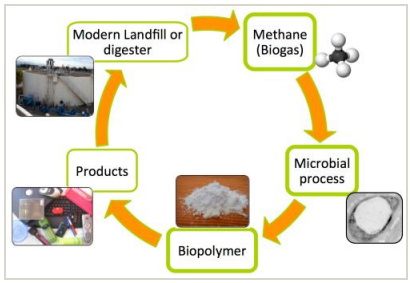
Images



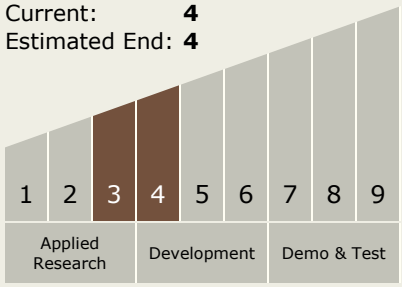
Briefing Chart Image
A novel, membrane-based bioreactor design to enable a closed-loop system on Earth and beyond, Phase I *(https://techport.nasa.gov/image/134043)*



Final Summary Chart Image
A novel, membrane-based bioreactor design to enable a closed-loop system on Earth and beyond, Phase I Project Image *(https://techport.nasa.gov/image/131276)*

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.1 Environmental Control & Life Support Systems (ECLSS) and Habitation Systems
    - TX06.1.4 Habitation Systems